Small Business Innovation Research/Small Business Tech Transfer

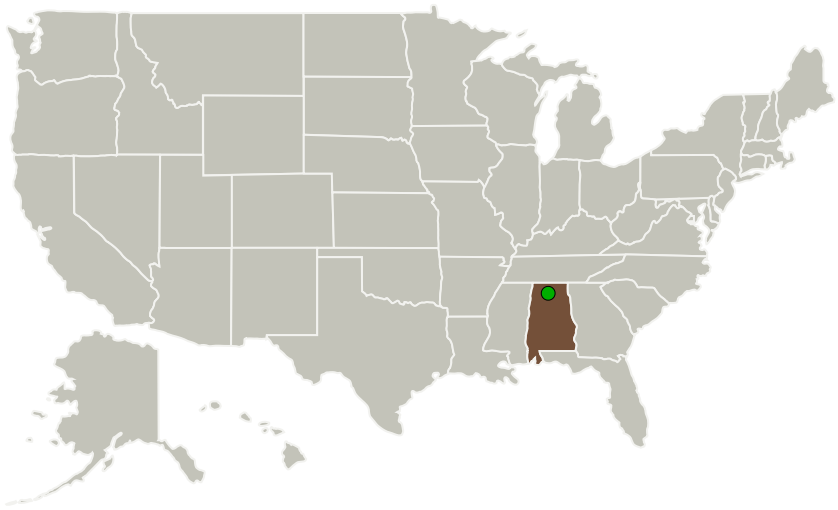
Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development, Phase I

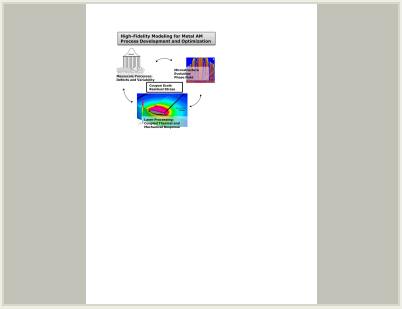
Completed Technology Project (2014 - 2014)

Project Introduction

Despite the rapid commercialization of additive manufacturing technology such as selective laser melting, SLM, there are gaps in process modeling and material property prediction that contribute to slow and costly process qualification and product certification. To address these gaps, CFDRC and our partner Dr. Kevin Chou, University of Alabama, will develop multiple computationally efficient, high-fidelity simulation tools for the SLM process. During Phase I the team will apply adaptive meshing to enable efficient thermomechanical simulations for centimeter size test coupon builds, leverage existing multiphase flow models to analyze particle size effects on material variations, apply phase field models to predict microstructure evolution, and evaluate model predictions against experimental characterization. During Phase II, the modeling tools will be extended to improve computational efficiency and scalability to aerospace component dimensions by further leveraging parallel computing and other acceleration techniques. The fidelity of the models will be enhanced to better predict distortion, residual stress, microstructure and defects from process conditions; and additional process data will be used to validate the resulting codes. The resulting toolset will be capable of efficiently predicting these dimensional and microstructural properties of SLM components from process conditions, while addressing important design and build features such as overhanging sections and build supports. The high-fidelity, physics based nature of the codes will allow straightforward application to new materials, and to guiding development of and verifying analytical physics models for process control.

Primary U.S. Work Locations and Key Partners





Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development Project Image

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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
The University of Alabama	Supporting Organization	Academia	Tuscaloosa, Alabama

Primary U.S. Work Locations
Alabama

Project Transitions

June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140627)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

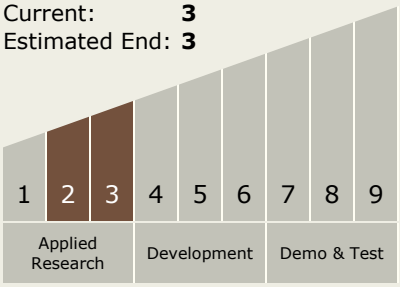
Carlos Torrez

Principal Investigator:

J. Vernon V Cole

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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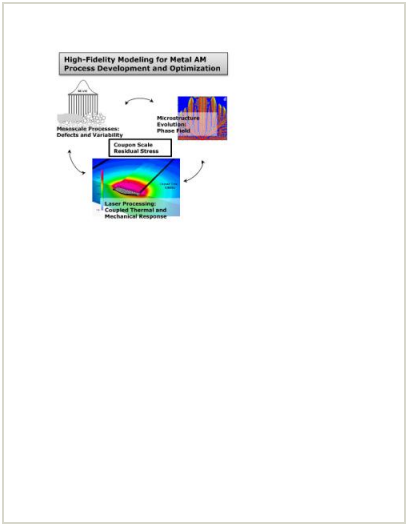
Images



Project Image
Multiple High-Fidelity Modeling Tools for Metal Additive Manufacturing Process Development Project Image
(https://techport.nasa.gov/image/133917)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System